

Navigation

Initial Requirements Document

14 January 1999

Background

This document defines the generic requirements for any future navigation architecture in support of the NAS Modernization and transition to Free Flight. These requirements have been defined to evaluate long-term navigation architectures in support of near-term investment decisions relating to satellite navigation (MNS#). This document is not intended to be used for the direct or indirect support of an acquisition program, and it does not replace or affect the GPS Operational Requirements Document, the WAAS Operational Requirements Document, the LAAS Requirements Document, or any associated FAA Specifications. If an evaluation of alternatives concludes that there should be a change in the long-term navigation architecture, then the WAAS and LAAS requirements documents will have to be updated as appropriate.

Requirements

The navigation architecture must provide a reliable area navigation capability. In other words, the service must provide the ability to accurately determine user time and position anywhere in the National Airspace System.

The navigation architecture must provide both lateral and vertical guidance for the final approach phase of flight. Accurate 3-dimensional guidance is part of a safety initiative to prevent controlled flight into terrain and approach & landing accidents.

The transition from the current navigation architecture to the future architecture must be benefits-driven: i.e., there must be an incentive for the user community to equip with this new capability that outweighs the cost.

The navigation architecture must be compatible with international navigation services. The navigation architecture should be capable of expansion through the rest of the world with minimal cost, to minimize the avionics required of US operators and to improve the safety of US citizens traveling abroad.

The performance requirements for the navigation services are defined in Table 1. These requirements have been extracted from the draft Standards and Recommended Practices (SARPS) for Global Navigation Satellite Systems (GNSS). They exclude failures incurred by the avionics.

Table 1 – Performance Requirements

Typical operation(s)	Accuracy lateral 95%	Accuracy vertical 95%	Integrity	Time to alert	Continuity	Availability	Associated RNP type(s)
En-route	2.0 NM	N/A	$1-10^{-7}/h$	5 min.	$1-10^{-4}/h$ to $1-10^{-8}/h$	0.99 to 0.99999	20 to 10
En-route, Terminal	0.4 NM	N/A	$1-10^{-7}/h$	15 s	$1-10^{-4}/h$ to $1-10^{-8}/h$	0.999 to 0.99999	5 to 1
Initial approach, Non-precision approach, Departure	220 m	N/A	$1-10^{-7}/h$	10 s	$1-10^{-4}/h$ to $1-10^{-8}/h$	0.99 to 0.99999	0.5 to 0.3
Instrument approach with vertical guidance (IPV)	220 m	9.1 m	$1-2 \times 10^{-7}$ per approach	10 s	$1-8 \times 10^{-6}$ in any 15 s	0.99 to 0.99999	0.3/125
Category I precision	16.0 m	7.7 m to 4.0 m	$1-2 \times 10^{-7}$ per approach	6 s	$1-8 \times 10^{-6}$ in any 15 s	0.99 to 0.99999	0.03/50 to 0.02/40

approach							
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A range of requirements is provided for availability and continuity to reflect the differing needs of various airspace. The specific requirement in these ranges depends on the density of air traffic in the region, available surveillance and communication services, air traffic management services (including automation), predominant weather conditions and economic demand. As a basis for comparison, the WAAS and LAAS requirements are identified in Table 2 as objectives for the navigation architecture: these requirements have been coordinated throughout the FAA and accepted as supporting NAS Modernization as defined by RTCA Task Force 3 Report and the NAS Architecture. Architectures that do not meet these objectives may still provide usable service, but may compromise other aspects of the NAS Modernization and could require augmentation from another navigation service or improved communication and independent surveillance.

A range of values is also specified for Category I precision approach. The 4.0 m (13 ft) requirement is based upon ILS specifications to minimize the validation and aircraft certification impact. For performance which is not consistent with ILS specifications, operational procedures or restrictions may apply.

Table 2 – Performance Objectives¹

Operation	Coverage	Continuity Objective	Availability Objective
en route operations	All U.S.-controlled airspace	$1-10^{-6}/h$	CONUS:0.99999 elsewhere: 0.999
terminal area operations	Within 30 NM of all U.S.-controlled airports	$1-10^{-5}/h$	CONUS:0.99999 elsewhere: 0.999
NPA	All U.S.-controlled airports	CONUS: $1-10^{-6}/h$	CONUS:0.99999 elsewhere: 0.999
3-dimensional approach (IPV)	All U.S.-controlled airports	$1-8 \times 10^{-6}$ in any 15 s	0.999
Precision approach	Many U.S.-controlled airports ²	$1-8 \times 10^{-6}$ in any 15 s	0.999 to 0.99999*

¹ All objectives have been extracted from WAAS Specification (FAA Specification E-2892C) and the LAAS Requirements Document.

² At least all U.S. controlled airports that qualify for a CAT I ILS must receive a fully-capable precision approach capability (0.999 availability). Airports that require greater availability or a lower decision height should be able to obtain this capability for their airport. A list of airports that have availability requirements >0.999 or require CAT II/III landing systems is provided in the LAAS Requirements Document.